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भाग 1 सामान्य विशिष्टि

Indian Standard

TRANSFORMERS AND INDUCTORS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT

PART 1 GENERIC SPECIFICATION

ICS 29.180

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

June 2000

Price Group 11

IS QC 260000 : 2000
IEC QC 260000 (1996)

Indian Standard

TRANSFORMERS AND INDUCTORS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT

PART 1 GENERIC SPECIFICATION

NATIONAL FOREWORD

This Indian Standard which is identical with IEC 1248-1/IEC QC 260000 (1996) 'Transformers and inductors for use in electronic and telecommunication equipment — Part 1 : Generic specification' issued by the International Electrotechnical Commission (IEC) was adopted by the Bureau of Indian Standards on the recommendation of Magnetic Components and Ferrite Materials Sectional Committee and approval of the Electronics and Telecommunication Division Council.

The text of the IEC has been approved as suitable for publication as Indian Standard without deviations. Certain conventions are, however, not identical to those used in Indian Standards. Attention is particularly drawn to the following:

a) Wherever the words 'International Standard' appear referring to this standard, they should be read as 'Indian Standard'.

b) Comma (,) has been used as a decimal marker while in Indian Standards the current practice is to use a point(.) as the decimal marker.

CROSS REFERENCES

In this adopted standard, reference appears to certain International Standards for which Indian Standards also exist. The corresponding Indian Standards which are to be substituted in their place are listed below along with their degree of equivalence for the editions indicated:

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC QC 001001 (1986) Basic rules of the IEC quality assessment system for electronic components (IECQ) Amendment 2 (1994)	IS QC 001001 : 1988 Basic rules of the IEC quality assessment system for electronic components (IECQ)	Technically Equivalent
IEC QC 001002 (1986) Rules of procedure of the IEC quality assessment system for electronic components(IECQ)	IS QC 001002 : 1988 Rules of procedure of the IEC quality assessment system for electronic components (IECQ)	Identical
IEC 68-1(1988) Environmental testing — Part 1 General and guidance Amendment 1 (1992)	a) IS 9000 (Part 1) :1988 Basic environental testing procedures for electronic and electrical items : Part 1 General (*first revision*)	Technically Equivalent
	b) IS 9001 (Part 1) :1984 Guidance for environmental testing : Part 1 General	do
IEC 68-2-2 (1974) Environmental testing — Part 2 : Tests — Tests B : Dry heat Amendment 1 (1993) Amendment 2 (1994)	IS 9000 (Part 2/Sec1 to 4) : 1977 Basic environmental testing procedures for electronic and electrical items : Part 2 Cold test	do

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
IEC 68-2-3 (1969) Environmental testing — Part 2 : Tests — Test Ca : Damp heat Steady state Amendment 2 (1994)	IS 9000 (Part 4) : 1979 Basic environmental testing procedures for electronic and electrical items : Part 4 Damp heat (steady state)	Technically Equivalent
IEC 68-2-6 (1982) Environmental testing — Part 2 : Tests—Test Fc and guidance : Vibration (sinusoidal)	a) IS 9000 (Part 8) :1981 Basic environmental testing procedures for electronic and electrical items : Part 8 Vibration (sinusoidal) test	do
	b) IS 9001 (Part 13) :1979 Guidance on environmental testing : Part 13 Vibration (sinusoidal) test	do
IEC 68-2-7 (1983) Environmental testing — Part 2 : Tests — Test Ga and guidance : Acceleration steady state Amendment 1 (1986)	a) IS 9000 (Part 9) :1984 Basic environmental testing procedures for electronic and electrical items : Part 9 Acceleration (steady state)	do
	b) IS 9001 (Part 15) : 1984 Guidance on environmental testing : Part 15 Acceleration (steady state)	do
IEC 68-2-13(1983) Environmental testing — Part 2 : Tests — Test M : Low air pressure	IS 9000 (Part 13) : 1981 Basic environmental testing procedures for electronic and electrical items: Part 13 Low air pressure test	do
IEC 68-2-14(1984) Environmental testing — Part 2 : Tests — Test N : Change of temperature Amendment 1 (1986)	IS 9000 (Part 14/Sec 1 to 3) : 1988 Basic environmental testing procedures for electronic and electrical items : Part 14 Change of temperature	do
IEC 68-2-20(1979) Environmental testing — Part 2 : Tests — Test T : Soldering	IS 9000 (Part 18/Sec 1 to 3) : 1981 Basic environmental testing procedures for electronic and electrical items : Part 18 Solderability test	do
IEC 68-2-21(1983) Environmental testing — Part 2 : Tests — Test U : Robustness of terminations and integral mounting devices	IS 9000 (Part 19/Sec 1 to 5) : 1986 Basic environmental testing procedures for electronic and electrical items : Part 19 Test U : Robustness of terminations and integral mounting devices	do
IEC 68-2-27(1987) Environmental testing — Part 2 : Tests — Test Ea and guidance : Shock	a) IS 9000 (Part 7/Sec 1) : 1979 Basic environmental testing procedures for electronic and electrical items : Part 7 Impact test, Section 1 Shock test	do
	b) IS 9001 (Part 17/Sec 1) : 1985 Guidance on environmental testing : Part 17 Impact test, Section 1 Shock test	do
IEC 68-2-29(1987) Environmental testing — Part 2 : Tests — Test Eb and guidance : Bump	a) IS 9000 (Part 7/Sec 2) : 1979 Basic environmental testing procedures for electronic and electrical items : Part 7 Impact test, Section 2 Bump test	do

International Standard	*Corresponding Indian Standard*	*Degree of Equivalence*
	b) IS 9001 (Part 17/Sec 2) : 1985 Guidance on environmental testing : Impact test, Section 2 Bump test	Technically Equivalent
IEC 617 : Graphical symbols for diagrams	IS 12032 : Graphical symbols for diagrams in the field of electrotechnology	Identical
IEC 651 : 1979 Sound level meters Amendment 1(1993)	IS 9779 : 1981 Sound level meters	Technically Equivalent
IEC 659 : Fire hazard testing	IS 11000 : Fire hazard testing	do
IEC 723 : Inductor and transformers cores for telecommunication	IS QC 250000 : Inductor and transformer cores for telecommunication	Identical
IEC 852-5 (1994) Outline dimensions of transformers and inductors for use in telecommunication and electronic equipment — Part 5 : Transformers and inductors using the series Q of C-cores	IS 11455 (Part 4) :1992 Outline dimensions of transformers and inductors for use in telecommunication and electronic equipment : Part 4 Transformers and inductors using Q series of C-cores	Technically Equivalent
ISO 31 : Quantities and units	IS 1890 : Quantities and Units	Identical

The concerned technical committee responsible for preparation of this standard has reviewed the provisions of the following international publications and has decided that they are acceptable for use in conjunction with this standard:

IEC Guide 102 : 1969	Electronic components. Specification structures for quality assessment (Quality approval and capability approval)
IEC QC 001004	Specifications list
IEC QC 001005	Register of firms, products and services approved under the IECQ System, including ISO 9000
IEC 50	International Electrotechnical Vocabulary (IEV)
IEC 68-2-1 (1990)	Environmental testing — Part 2 : Tests — Test A : Cold Amendment 1(1993), Amendment 2 (1994)
IEC 68-2-17 (1994)	Environmental testing — Part 2 : Tests — Test Q : Sealing
IEC 68-2-58 (1989)	Environmental testing — Part 2 : Tests — Test Td : Solderability, resistance to dissolution of metallization and to soldering heat of Surface Mounting Devices (SMD)
IEC 76-1 (1993)	Power transformers - Part 1 : General
IEC 367-1 (1982)	Cores for inductors and transformers for telecommunications — Part 1 : Measuring methods Amendment 1(1984), Amendment 2 (1992)
IEC 410 (1973)	Sampling plans and procedures for inspection by attributes
IEC 1007(1994)	Transformers and inductors for use in electronic and telecommunication equipment— Measuring methods and test procedures

Only the English language text of the International Standard has been retained while adopting it in this Indian Standard.

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Indian Standard

TRANSFORMERS AND INDUCTORS FOR USE IN ELECTRONIC AND TELECOMMUNICATION EQUIPMENT

PART 1 GENERIC SPECIFICATION

1 General

1.1 *Scope*

This part of IEC 1248 is a generic specification which prescribes the compliance requirements for manufacturers of transformers and inductors for use in electronic equipment in order to obtain capability approval in accordance with 11.7 of QC 001002, and the component test schedules to be used for the assessment of that capability. It applies to components, including polyphase types, that are primarily intended for use in electronic and telecommunication equipment.

This specification also prescribes requirements for marking, delayed delivery and ordering, and lists standard ratings and characteristics. In addition, it specifies how quality conformance testing should be carried out on ordered components.

NOTE – The transformers and inductors that are the subject of this specification may include other components essential to the operation of the device, e.g. capacitors associated with constant voltage transformers and resonated windings.

1.2 *Normative references*

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this part of IEC 1248. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 1248 are encouraged to investigate the possibility of applying the most recent editions of the normative documents listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC Guide 102: 1989, *Electronic components. Specification structures for quality assessment (Qualification approval and capability approval)*

IEC QC 001001: 1986, *Basic rules of the IEC Quality Assessment System for Electronic Components (IECQ)*
Amendment 2 (1994)

IEC QC 001002: 1986, *Rules of procedure of the IEC Quality Assessment System for Electronic Components (IECQ)*
Amendment 2 (1994)

IEC QC 001004: *Specifications list*

IEC QC 001005: *Register of firms, products and services approved under the IECQ System, including ISO 9000*

IEC 50: *International Electrotechnical Vocabulary (IEV)*

IEC 68-1: 1988, *Environmental testing, Part 1: General and guidance*
Amendment 1 (1992)

IEC 68-2: *Environmental testing – Part 2: Tests*

IEC 68-2-1: 1990, *Environmental testing – Part 2: Tests – Tests A: Cold*
Amendment 1 (1993), Amendment 2 (1994)

IEC 68-2-2: 1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*
Amendment 1 (1993), Amendment 2 (1994)

IEC 68-2-3: 1969, *Environmental testing – Part 2: Tests – Test Ca: Damp heat, steady state*

IEC 68-2-6: 1982, *Environmental testing – Part 2: Tests – Test Fc and guidance: Vibration (sinusoidal)*

IEC 68-2-7: 1983, *Environmental testing – Part 2: Tests – Test Ga and guidance: Acceleration, steady state*
Amendment 1 (1986)

IEC 68-2-13: 1983, *Environmental testing – Part 2: Tests – Test M: Low air pressure*

IEC 68-2-14: 1984, *Environmental testing – Part 2: Tests – Test N: Change of temperature*
Amendment 1 (1986)

IEC 68-2-17: 1994, *Environmental testing – Part 2: Tests – Test Q: Sealing*

IEC 68-2-20: 1979, *Environmental testing – Part 2: Tests – Test T: Soldering*
Amendment 2 (1987)

IEC 68-2-21: 1983, *Environmental testing – Part 2: Tests – Test U: Robustness of terminations and integral mounting devices*
Amendment 2 (1991), Amendment 3 (1992)

IEC 68-2-27: 1987, *Environmental testing – Part 2: Tests – Test Ea and guidance: Shock*

IEC 68-2-29: 1987, *Environmental testing – Part 2: Tests – Test Eb and guidance: Bump*

IEC 68-2-58: 1989, *Environmental testing – Part 2: Tests – Test Td: Solderability, resistance to dissolution of metallization and to soldering heat of Surface Mounting Devices (SMD)*

IEC 76-1: 1993, *Power transformers – Part 1: General*

IEC 367-1: 1982, *Cores for inductors and transformers for telecommunications – Part 1: Measuring methods*
Amendment 1 (1984), Amendment 2 (1992)

IEC 410: 1973, *Sampling plans and procedures for inspection by attributes*

IEC 617: *Graphical symbols for diagrams*

IEC 651: 1979, *Sound level meters*
Amendment 1 (1993)

IEC 695: *Fire hazard testing*

IEC 723: *Inductor and transformer cores for telecommunication*

IEC 852-5: 1994, *Outline dimensions of transformers and inductors for use in telecommunication and electronic equipment – Part 5: Transformers and inductors using the series Q of C-cores*

IEC 1007: 1994, *Transformers and inductors for use in electronic and telecommunication equipment – Measuring methods and test procedures*

ISO 31: *Quantities and units*

1.3 *General considerations*

For convenience, the following outline of the sequence of events in the capability approval procedure is given.

a) A manufacturer wishing to obtain capability approval writes a capability manual which clearly defines the scope of his design capability, manufacturing processes and quality control, to the satisfaction of the National Supervising Inspectorate (NSI).

b) The manufacturer, in collaboration with the NSI, selects sample components to demonstrate the limits of this scope, and the sample is assessed.

c) These components are submitted to a test programme in accordance with clause 3 of this generic specification.

d) When testing is successfully completed and the manufacturer's systems approved against the capability manual, capability approval is granted and the fact is published in QC 001005. The capability approval is maintained by periodic testing of sample components at the limits of the scope of the capability.

e) A potential customer makes an enquiry to the manufacturer for components within the scope of capability published in QC 001005 (or by CODUS).

f) The specification will be decided by the following two methods:

1) the specification is negotiated between the manufacturer and the customer until an agreed detail specification is finalized;

2) the detail specification is prepared by the manufacturer for his series of catalogue products. The customer will check the detail specification which will be modified by the customer's request if necessary.

NOTE – The detail specification is preferably based on one of the blanks included in the appropriate sectional specification.

g) The manufacturer allocates a reference number to the resulting detail specification which is filed and is available for scrutiny by the NSI. The component is inspected and released in accordance with this specification.

1.4 *Terminology*

For the purposes of this specification, the definitions of IEC 1007 apply, together with those given in IEC 50 and IEC 410.

1.5 *AQLs for particular parameter and for the whole sample of components*

1.5.1 *AQL for particular parameter (PAQL)*

The AQLs ratings designated for particular parameters listed in the inspection requirements of the detail specifications are the maximum numbers of defects per hundred units.

1.5.2 *AQL for the whole sample of components (SAQL)*

The AQLs can be designated as the maximum percent defective for the whole sample of components, as defined in 3.4.1.1, or for a selected group (or groups) of parameters specified in the CQC schedules and listed in 3.4.2 (e.g. for the group or groups of parameters which are for the customer of fundamental importance for the component operation).

AQLs ratings for the whole sample are decided by the method 1 described in 1.3 f).

1.6 *Letter symbols, signs and abbreviations*

Letter symbols, signs and abbreviations shall comply with ISO 31.

1.7 *Graphical symbols*

Graphical symbols shall comply with IEC 617.

1.8 *Marking of the component and package*

Unless otherwise specified in the detail specification, each component shall be marked as far as it is practical with the items given below, in the order of precedence stated:

a) type designation[1];
b) manufacturer's name or trade mark;
c) production lot number or date code[2].

All the above information shall appear also on the primary package.

NOTES

1 If a transparent package is used, the information may be marked on a label that can be read without opening the package.

2 For polyphase components it is desirable to give a connection symbol as defined in IEC 76-1.

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[1] For components supplied against the detail specification, the type designation will be that required by the customer. For components supplied against the detail specification for standard catalogue items, the type designation will be the manufacturer's type designation.

[2] Where the date also serves as lot identification, only the date code need appear on the component and package.

1.9 *Structurally similar components*

The requirements relating to structural similarity are superseded by the details of the capability approval procedure included in clause 3.

1.10 *Delayed delivery*

Components held for a period exceeding one year after acceptance testing shall be re-examined prior to despatch and shall satisfy the inspection requirements specified below, unless otherwise specified in the detail specification.

Solderability

Test Ta of IEC 68-2-20 or Test Td of IEC 68-2-58, as specified in the detail specification	Minimum: two terminations Maximum: 10 %

1.11 *Certified test records*

Certified test records (CTRs) shall be provided only when specifically required by the detail specification.

When so provided, CTRs shall be printed on size A4 paper in the format, for example, illustrated in annex A.

1.12 *Standard ratings and characteristics*

Preferred values for ratings and characteristics, in accordance with the appropriate part of IEC 68, are as follows:

a) Minimum ambient temperature (in accordance with IEC 68-2-1)

   −10 °C ± 3 °C
   −25 °C ± 3 °C
   −40 °C ± 3 °C
   −55 °C ± 3 °C
   −65 °C ± 3 °C

b) Maximum ambient temperature (in accordance with IEC 68-2-2)

   40 °C ± 2 °C
   55 °C ± 2 °C
   70 °C ± 2 °C
   85 °C ± 2 °C
   100 °C ± 2 °C
   125 °C ± 2 °C

c) Damp heat, steady state exposure (in accordance with IEC 68-2-3)

   4 days
   10 days
   21 days
   56 days

NOTE – to a), b), c) – In accordance with annex A of IEC 68-1, climatic categories are often expressed in the coded numerical form:
minimum ambient temperature/maximum ambient temperature/number of days exposure of damp heat

d) Shock (in accordance with IEC 68-2-27)

294 m/s^2, 18 ms
490 m/s^2, 11 ms
981 m/s^2, 6 ms

e) Bump (in accordance with IEC 68-2-29)

Number of bumps

1 000 ± 10
4 000 ± 10

This number of bumps is the total to be applied to any one sample.

Severity

98 m/s^2, 16 ms
390 m/s^2, 6 ms

f) Vibration (in accordance with IEC 68-2-6)

Frequency range

10 Hz to 55 Hz
10 Hz to 500 Hz
10 Hz to 2 000 Hz

Value of acceleration and displacement

Acceleration amplitude above cross-over frequency m/s^2	Displacement amplitude below cross-over frequency mm
49	0,35
98	0,75
196	1,5

g) Acceleration, steady state (in accordance with IEC 68-2-7)

98 m/s^2
196 m/s^2
490 m/s^2
981 m/s^2

h) Low air pressure (in accordance with IEC 68-2-13)

25 kPa
8 kPa

1.13 *Ordering information*

A component shall be the subject of a detail specification based on the appropriate detail specification relative to the component sub-family.

The specification shall comply with the generic specification and the appropriate sectional specification and, when read in conjunction with them, shall adequately describe the component.

The detail specification shall be allocated a component identity number either customer's, or manufacturer's or both parties' identification numbers, and the characteristics in the detail specifications such as ratings and dimensions shall fall within the scope of the manufacturer's capability approval.

When the contents of the specification have been agreed between customer and manufacturer, and the component or its family has been achieved for the capability approval, the manufacturer shall describe the appropriate sectional specification number (e.g. QC 260X00/FRR/2031).

After the sectional specification number has been described in the detail specification, it will be considered a contractual part of the order.

The manufacturer's chief inspector shall retain a copy of each completed detail specification which has been allocated such a reference.

1.14 *Quality conformance inspection*

Components ordered following the allocation of a manufacturer's reference number (e.g. QC 260X00/FRR/2031) to a completed detail specification shall be subjected to the tests described in that specification in accordance with the advice given in the relevant sectional specification.

NOTE – The tests to be carried out with their associated inspection levels and AQLs will be largely determined by the customer's requirements, subject always to the agreement of the manufacturer (see 1.13).

2 Tests

Tests specified in the capability approval schedules in this specification and listed in the detail specification (blank versions of which are recommended in the corresponding sectional specifications) shall be selected from and carried out in accordance with IEC 1007 supplemented as required by tests from IEC 68-2.

3 Capability approval procedures

3.1 *Eligibility for capability approval*

The primary stage of manufacture and all subsequent stages are to come under the direct surveillance of the approved chief inspector. The primary stage of manufacture shall be coil winding.

NOTE – Before supplying transformers or inductors in accordance with this specification, a manufacturer is required to obtain the approval of his inspection organization and facilities, followed by approval of his design and manufacturing capability, in accordance with clause 10 of QC 001002.

3.2 *Application for capability approval*

3.2.1 *General*

In making application for capability approval, the manufacturer shall describe the scope of each production capability for which approval is sought, in terms of the climatic category that the components are intended to withstand, the core type, the range of their mass and types of construction, in accordance with 3.2.2.1, 3.2.2.2, 3.2.2.3 and 3.2.2.4 respectively. Additional boundaries to the scope of a manufacturer's approval, as described in 3.7.2 b), may also be claimed.

3.2.2 *Scope of capability*

3.2.2.1 *General*

The limits of the scope of each capability shall be described as specified in 3.2.2.2 to 3.2.2.6.

3.2.2.2 *Environmental characteristics*

In seeking capability approval for a component, the manufacturer shall state the most severe climatic and dynamic categories the component will withstand, by specifying the minimum ambient temperature, the maximum ambient temperature, the duration of exposure to damp heat, the maximum bump and the maximum vibration from the values listed in 1.12 a), b), c), e) and f).

Additional environment category claims may be made for the maximum shock, maximum steady state acceleration and low air pressure with the values taken from 1.12 d), g) and h).

3.2.2.3 *Core type*

The manufacturer shall state the range of core types for which approval is sought.

NOTE – Examples of core types are as follows:

a) laminated cores (LC);
b) strip-wound cut cores (CC);
c) metallic ring-cores (RC);
d) ferrite cores (FC);
e) non-magnetic cores (NC).

(Non-magnetic implies air or a diamagnetic material.)

3.2.2.4 *Range of mass*

The manufacturer shall state the minimum and maximum mass (in kilograms) of the components for which capability approval is sought.

3.2.2.5 *Type of construction*

The manufacturer shall state the range of types of construction for which approval is sought, which may limit a component's claimed ability to withstand the stated mechanical environments.

NOTE 1 – Typical groups of types of construction for various core types are shown below; for appraisal, each group will require expansion to cover the manufacturer's range (see 3.4.1.2 b)). Where ferrite or ring-cores are employed in addition to laminated or strip-wound cut cores, this should be clearly stated.

Examples of groups of types are as follows:

a) Laminated cores
   1) bolted end frames and shrouds; 2, 4 or 6 clamping bolts;
   2) U-clamp with and without base plates;
   3) direct printed wiring board mounting, including integral fixings;
   4) various clamping bars and plates.

b) Strip-wound cut cores
   1) bolted end frames and shrouds;
   2) pattern H and J assemblies (see IEC 852-5);
   3) hermetically sealed assemblies;
   4) various clamping bars and plates.

c) Ring-cores
   – various clamping methods.

d) Ferrite cores
   1) printed wiring board mounting; integral pins;
   2) printed wiring board mounting; intermediate panel;
   3) stud mounted with metal casing;
   4) various clamping plates, separate brackets and adhesives.

e) Non-magnetic cores (including air)
   – various mounting methods.

NOTE 2 – Surface mounting technology may be applied in each of the above core types.

3.2.2.6 *Form of statement*

The scope of each production capability for which approval is sought shall be described, e.g. components having ring-cores, capable of withstanding climatic category 40/070/21 (see note to 1.12 a), b) and c)), having a range of mass between 0,2 kg and 2 kg.

3.2.3 *Add-on and built-in components*

Where the final component contains other components which themselves are covered by IEC generic specifications, it is desirable that these be released in accordance with the system.

Where any contained component is not so released, the final manufacturer's chief inspector shall be satisfied that its quality is adequate, by use of:

a) a procurement specification;

b) approval tests, and

c) incoming inspection procedures.

Examples of such components are add-on components, such as capacitors associated with constant voltage transformers, and built-in components, such as ferrite cores. In addition to the above requirements, add-on components shall be either electrically or mechanically attached or suitably identified.

NOTE – Ferrite cores are covered by the IEC 723 (QC 250000) series of specifications.

3.3 *Description of capability*

A manufacturer wishing to have his ability to supply components complying with this specification recognized shall comply with QC 001002 and shall demonstrate to the satisfaction of the NSI that suitable testing facilities are available, either by providing them himself or by making arrangements for testing to be carried out by an approved test laboratory. These testing facilities shall be appropriate to the use for which components are intended, e.g. signal, power or pulse application.

The manufacturer shall supply to the NSI and to the latter's satisfaction a description of capability preferably in the form of a capability manual. This document shall be confidential between the manufacturer and the NSI, and the NSI shall undertake to safeguard any of the contents of such a document from transmission to a third party.

This description of capability shall, either directly or by reference to the manufacturer's internal documents:

a) identify the boundaries of the capability for which he is seeking approval and which he is prepared to demonstrate in the capability approval tests;

b) prescribe the design disciplines and process control specifications appropriate to the range of products and manufacturing methods;

c) list the specifications for any materials necessary to maintain the quality of the range of products and the means of verification;

d) provide a brief description of the salient features of the method of construction;

e) provide a process flow chart clearly related to the prescribed design data and process control specifications, showing all the aspects of the capability for which approval is requested.

3.4 *Appraisal of capability*

3.4.1 *Capability qualifying components (CQC)*

3.4.1.1 A sample of six components, three of maximum mass and three of minimum mass, from each core type as defined in 3.2.2.3, shall be used to assess the claimed capability.

3.4.1.2 Test specimens shall be selected in accordance with a) and b) as follows:

a) Where more than one significantly different type of environmental protection is employed, e.g. oil filling or a method of resin casting, then three additional specimens selected by agreement between the manufacturer and the NSI to be the worst case will be required for each type of protection not assessed by components required by 3.4.1.1.

b) With the agreement of the NSI, the manufacturer shall aggregate his range of products within the claimed capability into types of construction (see 3.2.2.5). The aggregation shall be such that one component from each type of construction is selected to be the worst case for testing specimens claimed to be able to withstand the stated mechanical environments.

Components, otherwise required by 3.4.1.2 b), but already selected by the requirements of 3.4.1.1 and 3.4.1.2 a), and that are required to meet the test requirements of schedules 1, 2A and 2C, shall not be required for further testing by 3.4.1.2 b).

NOTE – Where significantly different types of environmental protection and types of construction have been assessed to the satisfaction of the NSI on CQCs of one core type as required by 3.4.1.2 a) and 3.4.1.2 b), then these features will not require additional assessment using CQCs from the remaining core types.

3.4.1.3 Where the test components are designed and produced solely for the purpose of obtaining capability approval, the manufacturer shall satisfy the NSI that the same controls and discipline will be applied to normal production in accordance with the capability manual.

3.4.1.4 Components without a prescribed method of mounting or unable to withstand four-days damp heat shall not be considered as capability qualifying components.

3.4.2 *CQC test schedules*

3.4.2.1 *General*

All the CQCs shall be subjected to the tests given in schedule 1 (see 3.4.3) in the order shown and shall comply with the requirements specified therein.

Two of the specimens, one of minimum mass and one of maximum mass for each core type, as required by 3.4.1.1, and one specimen from each additional significantly different type of environmental protection as required by 3.4.1.2 a), shall be subjected to the tests given in schedule 2A (see 3.4.4) in the order shown and shall comply with the requirements specified therein.

Two of the specimens, one of maximum mass and one of minimum mass for each core type, as required by 3.4.1.1, and one specimen from each additional significantly different type of environmental protection as required by 3.4.1.2 a) shall be subjected to the tests given in schedule 2B (see 3.4.5) in the order shown and shall comply with the requirements specified therein.

The remaining specimens, excluding those required by 3.4.1.2 b), shall be subjected to the tests prescribed in schedule 2C (see 3.4.6) in the order specified and shall comply with the requirements specified therein.

The specimens required by 3.4.1.2 b) shall be subjected to the tests contained in schedule 3 (see 3.4.7) in the order shown and shall comply with the requirements specified therein.

3.4.2.2 *Sample selection and test flow chart for the appraisal of capability* (see table 1)

Sequence a) of table 1 gives the number of CQCs for each schedule required for each core type (see 3.4.1.1).

Sequence b) gives the number of CQCs for each schedule required for each significantly different type of environmental protection that is not assessed by components in sequence a) (see 3.4.1.2 a)).

Sequence c) gives the number of CQCs for each schedule required for each type of construction that is not assessed by sequences a) or b) (see 3.4.1.2 b)).

3.4.2.3 *Failure procedure*

In the event of failure, the manufacturer shall take either the action described in a) or that described in b), as follows.

a) Initiate a failure analysis sequence to establish beyond doubt the cause of failure.

There are two possibilities:

1) failure of the test itself, e.g. test equipment failure or operator error;
2) design or process failures.

If the cause of failure is found in category 1) then, subject to the agreement of the NSI, either the component which apparently failed or a new component, if applicable, shall be resubmitted after the necessary corrective action has been taken. In the latter case, the full test sequence shall be performed.

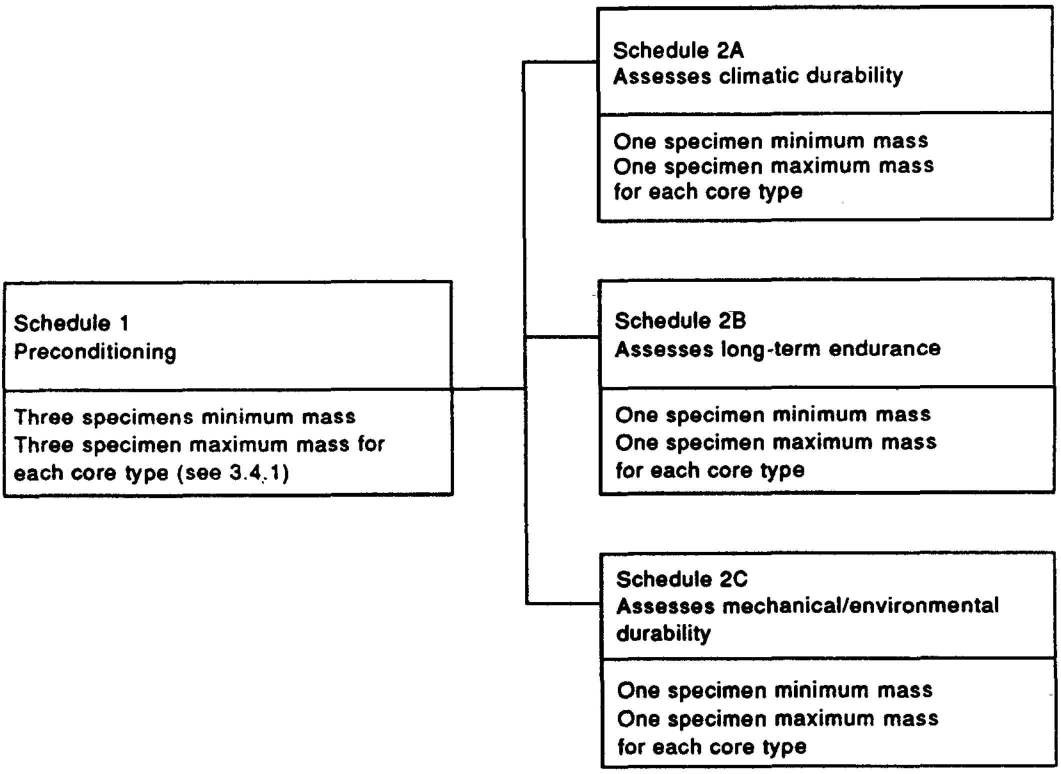
If the cause of failure is in category 2) a test programme, agreed between the manufacturer and the NSI, shall be performed to ensure that the cause of failure has been eradicated. This may also necessitate amendments to the capability manual and associated documentation. When this corrective action has been completed the full test sequence shall be repeated using new CQCs selected as required by 3.4.1.1 and 3.4.1.2.

b) Amend the scope of this declared capability with the agreement of the NSI.

Table 1 – Sample selection and test flow chart for the appraisal of capability (see 3.4.2.2)

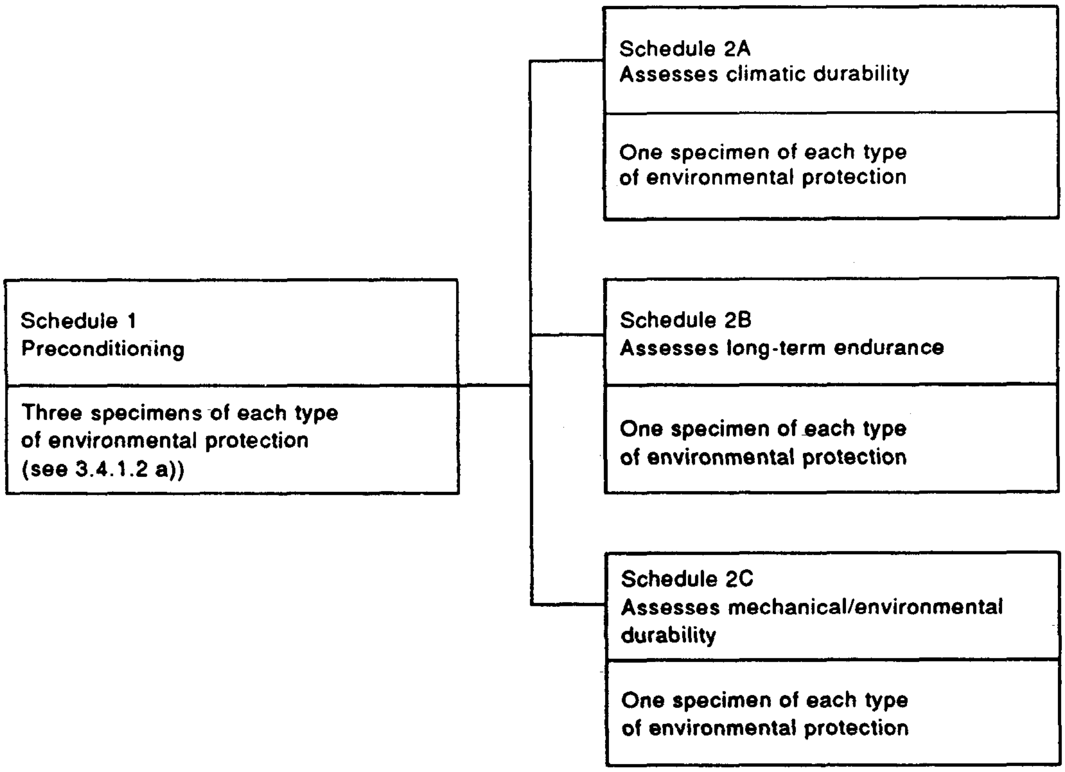
Sequence a) – Core types

For each core type the following tests are performed in the sample quantities shown.


Schedule 1
Preconditioning
Three specimens minimum mass
Three specimen maximum mass for each core type (see 3.4.1)
Schedule 2A
Assesses climatic durability
One specimen minimum mass
One specimen maximum mass
for each core type
Schedule 2B
Assesses long-term endurance
One specimen minimum mass
One specimen maximum mass
for each core type
Schedule 2C
Assesses mechanical/environmental durability
One specimen minimum mass
One specimen maximum mass
for each core type

Sequence b) – Types of environmental protection

For each core type environmental protection not assessed by sequence a) above, the following tests are performed in the sample quantities shown.



Schedule 1
Preconditioning

Three specimens of each type of environmental protection (see 3.4.1.2 a))

Schedule 2A
Assesses climatic durability

One specimen of each type of environmental protection

Schedule 2B
Assesses long-term endurance

One specimen of each type of environmental protection

Schedule 2C
Assesses mechanical/environmental durability

One specimen of each type of environmental protection

Sequence c) – Types of construction

For each type of construction not assessed by sequences a) or b) above, the following tests are performed on the sample quantities shown.

Schedule 3
Selective assessment of mechanical/environmental durability

One specimen of each type of construction (see 3.4.1.2 b))

NOTE – Tests from sequences a), b) and c) may be performed concurrently.

3.4.3 *Schedule 1 – Preconditioning*

Test	IEC 1007 reference	Conditions of test	Requirements
Effective inductance	4.4.4.1	The manufacturer shall state the conditions of test	The values shall be recorded
or no-load current	4.4.3.1		
DC winding resistance	4.4.1.1		
Soldering	–	Solderability test only Test Ta of IEC 68-2-20 For printed wiring applications method 1 shall be used For surface mounting components, testing shall be carried out in accordance with test Td of IEC 68-2-58	
Robustness of terminations	–	Test Ua_1, Ua_2, Ub, Uc or Ud of IEC 68-2-21, as appropriate	
Bump	–	The manufacturer shall state the severity and procedure These shall be selected from IEC 68-2-29, test Eb, with the provisos that the minimum severity for peak acceleration shall be 98 m/s² (10 g_n); that CQCs of mass less than 1 kg shall be subjected to test in each of the three mutually perpendicular planes; that CQCs of mass equal or greater than 1 kg shall be subjected to testing at least one plane; that the mass at which such transition in severity occurs shall be determined by test	
Additional tests (see note 2)	–	The manufacturer shall select the test(s) from IEC 68-2 stating the severity and procedure	
Sealing[1)]	–	Test Qc or Qd of IEC 68-2-17 As specified on relevant CQC drawing	There shall be no leakage
Insulation resistance (hot)	4.4.2.3	Measurement to be made after the maximum winding temperature has been maintained for 6 h (or other specified period)	For single phase components ≤120 kg shall be not less than 50 MΩ For polyphase components, and single phase components >120 kg, shall be not less than 20 MΩ
Visual inspection	4.2		
Continuity	4.4.1.2	All windings The manufacturer shall state the maximum measuring current if necessary	
Effective inductance	4.4.4.1	The component shall be allowed to reach thermal stability and the test shall then be made under the same electrical and environmental conditions as for the initial measurement	Shall differ by not more than 10 % from the initial value for components having cores with an intentional gap For other components inductance shall decrease by not more than 30 % of its initial value, and the no-load current shall increase by not more than 30 % of its initial value There is no limit to the increase of inductance or the decrease of the non-load current
or no-load current	4.4.3.1		

(Continued on page 20)

Schedule 1 – Preconditioning (concluded)

Test	IEC 1007 reference	Conditions of test	Requirements
DC winding resistance	4.4.1.1		Shall differ by not more than 5 % from the initial value

NOTES

1 In schedule 2A, 2B and 2C, the initial tests are not required if these schedules are initiated within one week of completion of the final tests of schedule 1.

2 These tests are not mandatory but are required if the manufacturer claims additional environmental capabilities in respect of resistance to dynamic stress (see 3.7.2 b)).

1) Applicable only to sealed components.

3.4.4 *Schedule 2A – Assessment of climatic durability*

Test	IEC 1007 reference	Conditions of test	Requirements
Effective inductance 1) or no-load current	4.4.4.1 4.4.3.1	The manufacturer shall state the conditions of test	The values shall be recorded
DC winding resistance 1)	4.4.1.1		
Climatic sequence	4.5.10	The severity shall be in accordance with the component's claimed climatic category	
Visual inspection	4.2		
Continuity	4.4.1.2	All windings The manufacturer shall state the maximum measuring current if necessary	
Insulation resistance (standard atmosphere)	4.4.2.3	The manufacturer shall state the conditions of test	For single phase components ≤120 kg shall be not less than 200 MΩ For polyphase components, and single phase components >120 kg, shall be not less than 100 MΩ
Effective inductance or no-load current	4.4.4.1 4.4.3.1	The component shall be allowed to reach thermal stability and the test shall then be be made under the same electrical and environmental conditions as for the initial measurement	Shall differ by not more than 10 % from the initial value for components having cores with an intentional gap For other components the inductance shall decrease by not more than 30 % of its initial value, and the no-load current shall increase by not more than 30 % of its initial value There is no limit to the increase of inductance or the decrease of the no-load current
DC winding resistance	4.4.1.1		Shall differ by not more than 5 % from the initial value

1) Applicable only to sealed components.

3.4.5 *Schedule 2B – Assessment of long-term endurance*

Test	IEC 1007 reference	Conditions of test	Requirements
Effective inductance[1)] or no-load current	4.4.4.1 4.4.3.1	The manufacturer shall state the conditions of test	The values shall be recorded
DC winding resistance[1)]	4.4.1.1		
Long-term endurance (life test)	4.6.2		
Continuity	4.4.1.2	All windings The manufacturer shall state the maximum measuring current if necessary	
Insulation resistance (standard atmosphere)	4.4.2.3	The manufacturer shall state the conditions of test	For single phase components ≤120 kg shall be not less than 200 MΩ For polyphase components, and single phase components >120 kg, shall be not less than 100 MΩ
Effective inductance or no-load current	4.4.4.1 4.4.3.1	The component shall be allowed to reach thermal stability and the test shall then be made under the same electrical and environmental conditions as for the initial measurement	Shall differ by not more than 10 % from the initial value for components having cores with an intentional gap For other components the inductance shall decrease by not more than 30 % of its initial value, and the no-load current shall increase by not more than 30 % of its initial value There is no limit to the increase of inductance or the decrease of the no-load current
DC winding resistance	4.4.1.1		Shall differ by not more than 5 % from the initial value

[1)] Applicable only to sealed components.

3.4.6 *Schedule 2C – Assessment of mechanical/environmental durability*

Test	IEC 1007 reference	Conditions of test	Requirements
Effective inductance[1] or no-load current	4.4.4.1 4.4.3.1	The manufacturer shall state the conditions of test	The values shall be recorded
DC winding resistance[1]	4.4.1.1		
Quality of solder joints	4.2.2	Resistance to soldering heat only Method 1B of test Tb of IEC 68-2-20 For surface mounting components, testing shall be carried out in accordance with test Td of IEC 68-2-58	
Continuity	4.4.1.2	All windings The manufacturer shall state the maximum measuring current if necessary	
Vibration	–	The manufacturer shall state the severity and procedure. These shall be selected from IEC 68-2-6, test Fc, with the provisos that the minimum severity for acceleration amplitude shall be 19,6 m/s² (2 g_n); that CQCs of mass less than 1 kg shall be subjected to test in each of the three mutually perpendicular planes; that CQCs of mass equal or greater than 1 kg shall be subjected to test in at least one plane; that the mass at which such transition in severity occurs shall be determined by test	
Continuity	4.4.1.2	All windings To be made under the same conditions as all previous continuity measurements	
Visual inspection	4.2		
Temperature rapid change	–	In accordance with test Na of IEC 68-2-14 Severity according to component's claimed climatic category	
Continuity	4.4.1.2	All windings To be made under the same conditions as all previous continuity measurements	
Damp heat, steady state	–	In accordance with test Ca of IEC 68-2-3 Severity according to the component's claimed climatic category	
Insulation resistance (standard atmosphere)	4.4.2.3	The manufacturer shall state the conditions of test	For single phase components ≤120 kg shall be not less than 200 MΩ For polyphase components, and single phase components >120 kg, shall be not less than 100 MΩ
Effective inductance or no-load current	4.4.4.1 4.4.3.1	The component shall be allowed to reach thermal stability and the test shall then be made under the same electrical and environmental conditions as for the initial measurement	Shall differ by not more than 10 % from the initial value for components having cores with an intentional gap For other components the inductance shall decrease by not more than 30 % There is no limit to the increase of inductance or the decrease of the no-load current
DC winding resistance	4.4.1.1		Shall differ by not more than 5 % from the initial value

---

[1] Applicable only to sealed components.

3.4.7 *Schedule 3 – Selective assessment of mechanical/environmental durability*

Test	IEC 1007 reference	Conditions of test	Requirements
Effective inductance[1] or no-load current	4.4.4.1 4.4.3.1	The manufacturer shall state the conditions of test	The values shall be recorded
DC winding resistance	4.4.1.1		
Soldering[1]	–	Solderability test only Test Ta of IEC 68-2-20 For printed wiring applications method 1 shall be used For surface mounting components, testing shall be carried out in accordance with test Td of IEC 68-2-58	
Bump	–	The manufacturer shall state the severity and procedure These shall be selected from IEC 68-2-29, Test Eb, with the provisos that the minimum severity for peak acceleration shall be 98 m/s^2 (10 g_n); that CQCs of mass less than 1 kg be subjected to test in each of the three mutually perpendicular planes; that CQCs of mass equal or greater than 1 kg shall be subjected to testing at least one plane; that the mass at which such transition in severity occurs shall be determined by test	
Vibration	–	To be selected from IEC 68-2-6, test Fc, with the same provisos as for bump, but with minimum severity 19,6 m/s^2 (2 g_n)	
Additional tests (see note)	–	The manufacturer shall select the test(s) from IEC 68-2 stating the severity and procedure	
Robustness of terminations	–	Test Ua_1, Ua_2, Ub, Uc or Ud of IEC 68-2-21 as appropriate	
Sealing[2]	–	Test Qc or Qd of IEC 68-2-17	There shall be no leakage
Visual inspection	4.2		There shall be no damage
Climatic sequence	4.5.10	The severity shall be in accordance with the component's claimed climatic category	
Continuity	4.4.1.2	All windings The manufacturer shall state the maximum measuring current if necessary	
Insulation resistance (standard atmosphere)	4.4.2.3	The manufacturer shall state the conditions of test	For single phase components ≤120 kg shall be not less than 200 MΩ For polyphase components, and single phase components >120 kg, shall be not less than 100 MΩ
Effective inductance or no-load current	4.4.4.1 4.4.3.1	The component shall be allowed to reach thermal stability and the test shall then be made under the same electrical and environmental conditions as for the initial measurement	Shall differ by not more than 10 % from the initial value for components having cores with an intentional gap For other components the inductance shall decrease by not more than 30 % of its initial value, and the no-load current shall increase by not more than 30 % of its initial value. There is no limit to the increase of inductance or the decrease of the no-load current
DC winding resistance	4.4.1.1		Shall differ by not more than 5 % from the initial value

NOTE – These tests are not mandatory but are required if the manufacturer claims additional environmental capability in respect of resistance to dynamic stress (see 3.7.2 b)).

[1] Only required for terminations not already tested in schedule 1.

[2] Applicable only to sealed components.

3.5 *Announcement of capability approval*

3.5.1 *Capability approval test reports*

After the completion to the satisfaction of the NSI of the appraisal of the capability claimed by the manufacturer, a capability approval report shall be prepared and distributed.

Copies of test reports shall be prepared and distributed as follows:

- two copies to the NSI;
- one copy to be retained by the manufacturer.

The test reports shall be dated and shall include the following information:

a) *General*:
   1) manufacturer's name and address;
   2) place of manufacture if different from 1);
   3) name and address of approved test laboratory, where appropriate;
   4) generic specification number, issue and amendment state;
   5) details of capability qualifying component tested.

b) *Summary of test information, including the following:*
   1) test conditions;
   2) number of specimens tested;
   3) number of failures allowed;
   4) number of failures found.

c) *Measurement record*

   This shall be a record of the measurements taken before and after the various mechanical, environmental and endurance tests for which post-test limits of final measurements are appropriate.

3.5.2 *Abstract of description of capability*

When capability approval is granted, the manufacturer shall submit an abstract of description of capability for publication in QC 001005 (IECQ Register of approvals).

This abstract of description of capability shall include the following information for limits of capability:

a) physical limits;
b) electrical limits;
c) environmental limits;
d) other additional limits.

Annex B shows a sample format of such an abstract.

3.6 *Maintenance of capability approval*

3.6.1 *General*

The programme of maintenance of each capability approval shall comprise the surveillance of normal production components by quality conformance inspection (see 1.14), and in addition the periodic testing of capability qualifying components as specified in 3.6.2 to 3.6.5 and illustrated in table 2. The capability qualifying components shall include all components required in 3.4.1.1. In addition, the capability qualifying components shall include those components required by 3.4.1.2 a) but may exclude those components required by 3.4.1.2 b). The manufacturer shall satisfy the NSI that the same controls and disciplines have been applied to these capability qualifying components as to the normal production components, in accordance with the capability manual.

3.6.2 *Annual testing*

At intervals not exceeding one year, a sample comprising two components of each core type and one component having each additional significantly different type of environmental protection shall be selected at random from production such that the capability established in production during the period is fully tested.

The sample shall be subjected to the tests contained in CQC schedules 1 and 2A (see 3.4.3 and 3.4.4 respectively) and shall comply with the requirement given therein.

3.6.3 *Three-yearly testing*

At intervals not exceeding three years, a sample shall be selected in accordance with 3.4.1.1, 3.4.1.2 and 3.6.1 such that the boundaries of the claimed capability are fully tested.

The sample shall be subjected to the tests contained in schedules 1, 2A, 2B and 2C (see 3.4.3, 3.4.4, 3.4.5 and 3.4.6 respectively), as required by 3.4.2.1 and 3.4.2.2, and shall comply with the requirements given therein.

3.6.4 *Additional boundaries to the approval*

Where the manufacturer claims additional boundaries to his approval, the requirements of 3.7.3 apply.

3.6.5 *Procedure in the event of failure*

In the event of failure during testing as required by 3.6.3 or 3.6.4, the procedure given in 3.4.2.3 of this specification shall apply.

3.7 *Changes to the approved capability*

3.7.1 The manufacturer may apply for the boundaries of his approval to be contracted or extended. This entails the amendment of his capability manual, amendment of the published abstract of his approval and a demonstration, by means of suitable capability qualifying components, of the changed boundaries of the approval.

3.7.2 For the purpose of the demonstration and subsequent approval maintenance (should this be desired), it is important to distinguish the nature of the modification to the capability approval as being either:

a) a redefining of the boundaries described in the scope of the approval and which were established by the mandatory tests given in 3.4, or

b) the introduction of additional boundaries relating to environmental tests which are not a mandatory requirement for approval, but which may be selected from IEC 68-2.

These boundaries are further distinguished as being either:

1) essentially dynamic in nature, e.g. resistance to shock, or

2) essentially climatic in nature, e.g. resistance to salt mist.

3.7.3 For the demonstration and maintenance of boundaries categorized as redefined or additional (dynamic) as in 3.7.2 a) and 3.7.2 b) 1) above, the requirements of 3.4 and 3.6 prevail.

Manufacturers who have already been approved and who wish to extend their capability to include an additional or an extended dynamic boundary may demonstrate their capability by selecting samples as detailed in 3.4 (except that one sample may be taken instead of three and the tests are carried out in accordance with schedule 3, modified to include the additional boundary). Maintenance shall be carried out as specified in 3.6, the additional dynamic boundary being included after the bump test.

For the demonstration of boundaries categorized as additional (climatic) as in 3.7.2 b) 2), specimens shall be selected from CQCs which have already been subjected to the range of tests appropriate to them so as to represent the worst case for each additional test condition. The test sample shall, therefore, comprise one specimen for each boundary unless it can be shown that particular samples represent more than one worst case, when the tests may be carried out successively on the same component(s). Where appropriate, and with the agreement of the NSI, the use of electrical rejects and materials samples may be employed. The manufacturer shall state the test(s), selected from IEC 68-2, giving the severity, procedure and acceptance criteria.

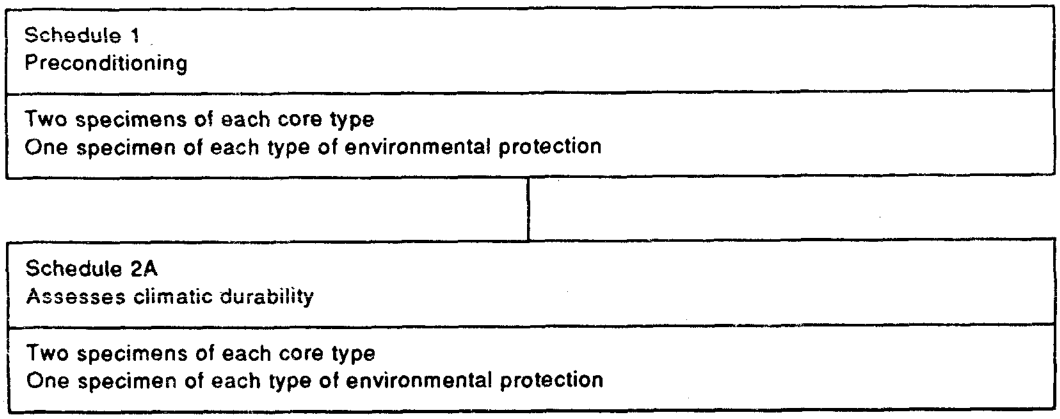
For the maintenance of approval to these (climatic) boundaries, these tests shall be carried out at intervals not exceeding three years.

3.7.4 Components may be released to a customer's detail specification which invokes requirements necessitating such changes to the boundaries of the approval as are given in this specification, when the appropriate tests are complete and to the satisfaction of the NSI. Environmental testing, and the particular component features involved, other than those given above, remain the exclusive and mutual responsibility of the manufacturer and his customer, and are not covered by the capability approval.

Table 2 – Sample selection and test flow chart for the maintenance of capability approval (see 3.6)

The following tests are performed in the sample quantities shown:

Annual testing (see 3.6.2)



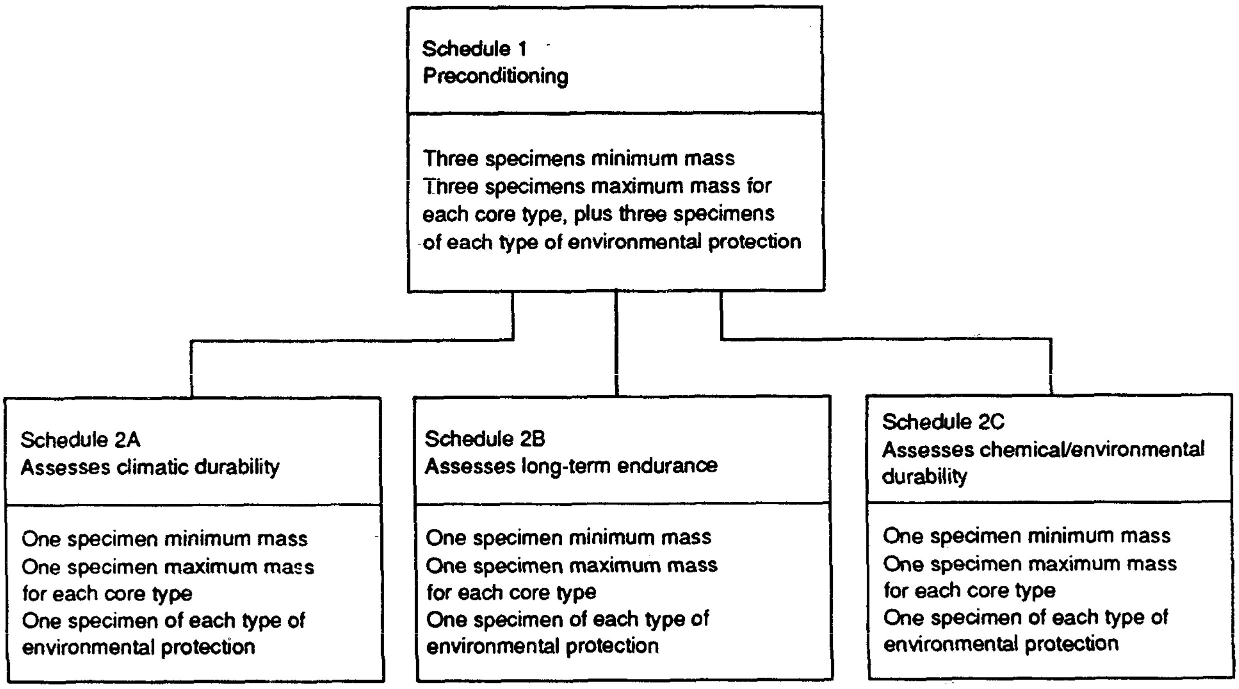
Schedule 1
Preconditioning

Two specimens of each core type
One specimen of each type of environmental protection

Schedule 2A
Assesses climatic durability

Two specimens of each core type
One specimen of each type of environmental protection

Three-year testing (see 3.6.3)



Schedule 1
Preconditioning

Three specimens minimum mass
Three specimens maximum mass for each core type, plus three specimens of each type of environmental protection

Schedule 2A
Assesses climatic durability

One specimen minimum mass
One specimen maximum mass for each core type
One specimen of each type of environmental protection

Schedule 2B
Assesses long-term endurance

One specimen minimum mass
One specimen maximum mass for each core type
One specimen of each type of environmental protection

Schedule 2C
Assesses chemical/environmental durability

One specimen minimum mass
One specimen maximum mass for each core type
One specimen of each type of environmental protection

Annex A
(informative)

Sample format for certified test record
(see 1.11)

Quality conformance tests

Component manufacturer:

Place of manufacture:

Manufacturer's reference No.: QC 260X00/FRR/2031

Description of component:	Details appropriate to the type and style corresponding to a stated sectional specification should be included here, and the form of construction, e.g. strip-wound cut cores, laminated cores, ferrite cores, ring-cores, non-magnetic cores, and other, should be stated.
Current six-month period:	e.g. 1 January 19XX to 1 July 19XX
Current three-year period:	1 January 19(XX-1)

This certified test record is a complete and accurate record of the tests carried out in accordance with the specified procedures.

Chief Inspector:

Supervising Inspector:

Attributes information (go/no go tests)

Test, name and reference	Current six-month period		Current three-year period	
	Tested	Defectives	Tested	Defectives
In accordance with the requirements of the detail specification				

Measurement data

This section lists the measured results for stated tests, together with the limiting values and a statement of the total number of defectives.

Annex B
(informative)

Sample format for abstract of description of capability for inclusion in QC 001005 (IECQ Register of approvals)

Transformers and inductors

Certificate number

Sectional specification

Detail specification

Manufacturer's name and address

Date of capability approval

Approval authority

Limits of capability

This limit is for example only; the actual list shall include all the mandatory and such of the additional limits as are selected from sectional and detail specifications.

Physical limits

Core type
Range of mass (or maximum/minimum sizes)
Type of construction

Electrical limits

Range of VA
Frequency
Maximum voltage or current

Environmental limits

Severest climatic category
Maximum and minimum ambient temperatures
Severest mechanical/environmental category
- vibration;
- bump.

Other additional limits

- Shock.

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This Indian Standard has been developed from Doc : No. LTD 13 (1623).

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed at New India Printing Press, Khurja, India